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Rooftop Air-Conditioner for a Vehicle, in particular a Bus

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Claims

1. A rooftop air-conditioner (4) operating according to the cold vapor-compression principle using an internal coolant for a vehicle, in particular a bus, in which
  - a sequence made up of a high-pressure side heat exchanging device (54) with associated fan device (16), followed by an expansion device (52) and an evaporation device (36) that are in contact on the inside with a coolant,
  - an internal channel arrangement (12), relative to the rooftop air-conditioner (4), to convey air to be conditioned, which exchanges heat with the evaporation device (36),
  - and a modular construction (6) of a high-pressure side heat exchanging device (54) with associated fan device (16) in its own housing (6, 14)are provided,  
characterized in that  
connections (34) for the coupling of identical said high-pressure heat exchanging device (54) modules (6a, 6b) can be provided, prepared or designed, and

that the modules (6 and 6a, 6b) are designed for grid-like coupling (7, 8; 34) of modules of identical output and/or modules of stepped output.

2. A rooftop air-conditioner according to claim 1, characterized in that the coupling of the modules (6 and 6a, 6b) is done in the longitudinal direction of the vehicle.

3. A rooftop air-conditioner according to claim 1 or 2, characterized in that the high-pressure side heat exchanging device (54) to convey the internal coolant contains round tubes (20).

4. A rooftop air-conditioner according to claim 1 or 2, characterized in that the high-pressure side heat exchanging device (54) to convey the internal coolant contains flat tubes (21).

5. A rooftop air-conditioner according to one of claims 1 through 4, characterized in that the housing (23) of the high-pressure side heat exchanging device (54) is dimensioned such that either round tubes (20) or flat tubes (21) can be installed to convey the internal coolant.

6. A rooftop air-conditioner according to one of claims 1 through 5, characterized in that it also contains a heating device (40) to heat the air to be conditioned.

7. A rooftop air-conditioner according to claim 6 characterized in that the heating device has at least one heating heat exchanger (40) that is located inside the evaporation device (36) with its exterior fins being aligned with the airway of the air to be conditioned and alongside the external fins of at least one evaporating heat exchanger (36).

8. A rooftop air-conditioner according to one of claims 1 through 7, characterized in that at least some, preferably all, modules (6a, 6b) in the grid are of the same longitudinal length.

9. A rooftop air-conditioner according to one of claims 1 through 8, characterized in that the module (6 or 6a, 6b) also contains an evaporating device (36) and at least one section of an internal channel arrangement (12).

10. A rooftop air-conditioner according to one of claims 1 through 8, characterized in that the internal channel arrangement (12) is provided separately from the module (6 or 6a, 6b) and is connected to it laterally.

11. A rooftop air-conditioner according to one of claims 1 through 10, characterized in that the evaporating device (36) is arranged to the side of the internal channel arrangement (12).

12. A rooftop air-conditioner according to one of claims 1 through 11, characterized in that the evaporating device (36) and/or the internal channel arrangement (12) is itself designed modularly (10; 14) with its own housing (24; 25).

13. A rooftop air-conditioner according to one of claims 1 through 12, characterized in that it is subdivided in the transverse direction of the vehicle into sections and or modules (6, 10, 14) and that the relative angular position between adjacent pairs of sections, modules or section and module is adjustable (44; 46) in the transverse direction of the vehicle.
14. A rooftop air-conditioner according to claim 13, characterized in that at least one pair of sections, modules or of section and module is connected by means of a hinged (44) and/or soft bending (46) connection.
15. A rooftop air-conditioner according to claim 13 or 14, characterized by a bridging device (42) slid in between the pairs of sections, modules or between section and module.
16. A rooftop air-conditioner according to one of claims 1 through 15, characterized in that different output levels of the module (6, 14) can be selected by using a different number of identical blower units (38) that can be installed in the evaporating device (36) and/or by a different number of identical fan units (16) that can be installed in the high-pressure side heat exchanging device (54).
17. A rooftop air-conditioner according to one of claims 1 through 16, characterized in that the high-pressure side heat exchanging device (54), the evaporating device (36) and the at least one section of inner channel arrangement (12) each extends in the longitudinal direction of the vehicle (and of the module 6, 10, 14).

18. A rooftop air-conditioner according to one of claims 1 through 17, characterized by a rooftop air-conditioner (4) construction in the transverse direction with a central arrangement of high-pressure side heat exchanging device (54), inner channel arrangements (12) on either side of it, followed by evaporating devices (36) on either side of that in turn, said evaporating devices coupled to a respective expansion device (52).

19. A rooftop air-conditioner according to one of claims 1 through 18, characterized in that the inner channel arrangement (12) of the rooftop air-conditioner (4) has a space for installation (in 24) in which a switching valve (26) is or can be installed [to switch] between conditioning the internal air in the vehicle, conditioning outside air fed to the vehicle, and/or a combination of the two.

20. A rooftop air-conditioner according to one of claims 1 through 19, characterized in that in at least one module (6 or 6a, 6b), the high-pressure side heat exchanging device (54) is supplemented with a compression device (50) in addition to a fan device (16).

21. A rooftop air-conditioner according to claim 20, characterized in that the supplemental compression device (50) in turn is designed modularly (56) with its own housing.

22. A rooftop air-conditioner according to one of claims 1 through 21, characterized in that in at least one module (6 or 6a, 6b), the high-pressure side heat exchanging device (54) is supplemented with a fuel cell device (64) in addition to a fan device (16).
23. A rooftop air-conditioner according to claim 22, characterized in that the supplemental fuel cell device (64) in turn is designed modularly (68) with its own housing (66).
24. A rooftop air-conditioner according to claim 22 or 23, characterized in that the fuel cell device (64) is provided with its own cooling device (70) inside the rooftop air-conditioner or its own cooling module.
25. A rooftop air-conditioner according to claim 23 or 24, characterized in that the internal coolant is also provided as the coolant for the fuel cell device (64).
26. A rooftop air-conditioner according to one of claims 22 through 25, characterized in that a tank (80) for the fuel of the fuel cell device (64) is incorporated into the rooftop air-conditioner (4).
27. A rooftop air-conditioner according to claim 26, characterized in that the tank (80) is in turn designed as a module (76) by itself.
28. A rooftop air-conditioner according to claims 23 and 26, characterized in that the tank (80) is incorporated into the module (68) of the fuel cell device (64).

29. A rooftop air-conditioner according to one of claims 1 through 28, characterized in that the operating mode is designed to be supercritical and that the high-pressure heat exchanging device (54) has a gas cooler for the internal coolant.